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Modulational instability and study of freak waves in an ion beam plasma with two temperature superthermal electrons

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From past few decades, there has been a great deal of interest in understanding different types of nonlinear solitary structures in various kind of plasmas. The study of ion-acoustic solitary waves in multi-component plasmas holds an mportant place in both theoretical and experimental point of views. The satellite observations in space plasma confirm that these waves generally occur in association with ion beams. It was also shown that the ion acoustic solitary waves are associated with up flowing ion beams. The propagation of an ion beam into a plasma can strongly affect the conditions for the occurrence of solitary waves and may modify their properties. Most of the space and astrophysical environments show the existence of superthermal particles. These particles are well modelled by the kappa type distribution. We have derived the nonlinear Schrodinger equation (NLSE) using multiple scale perturbation technique. From the nonlinear and dispersion coefficients, we have studied the instability conditions. Both dark and bright envelope solitons are observed. It is observed that physical parameters (e.g., beam concentration, superthermality of electrons and beam velocity) play a significant role to modify the envelope solitary structures associated with these low frequency waves. The characteristics of first- and second-order freak waves has been studied in detail in the presence of ion beam. The findings of the present study may be useful in understanding the amplitude modulation of low frequency solitary waves in various space/astrophysical plasma environments such as Saturn's magnetosphere, polar cap region of Earth's magnetosphere where ions, two temperature superthermal electrons and ion beams are present.

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